

# **MODIS Aerosol Team: Progress and Directions for CLAMS data analysis**

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**with intensive collaboration with the COVE in-situ Team (Ken  
Rutledge, et al.), Peter V. Hobbs and Jens Redemann with the CV580  
aircraft**

**In situ and Remote Sensing  
Measurements during CLAMS.**

**(CAR results will be shown later by Charles Gatebe)**

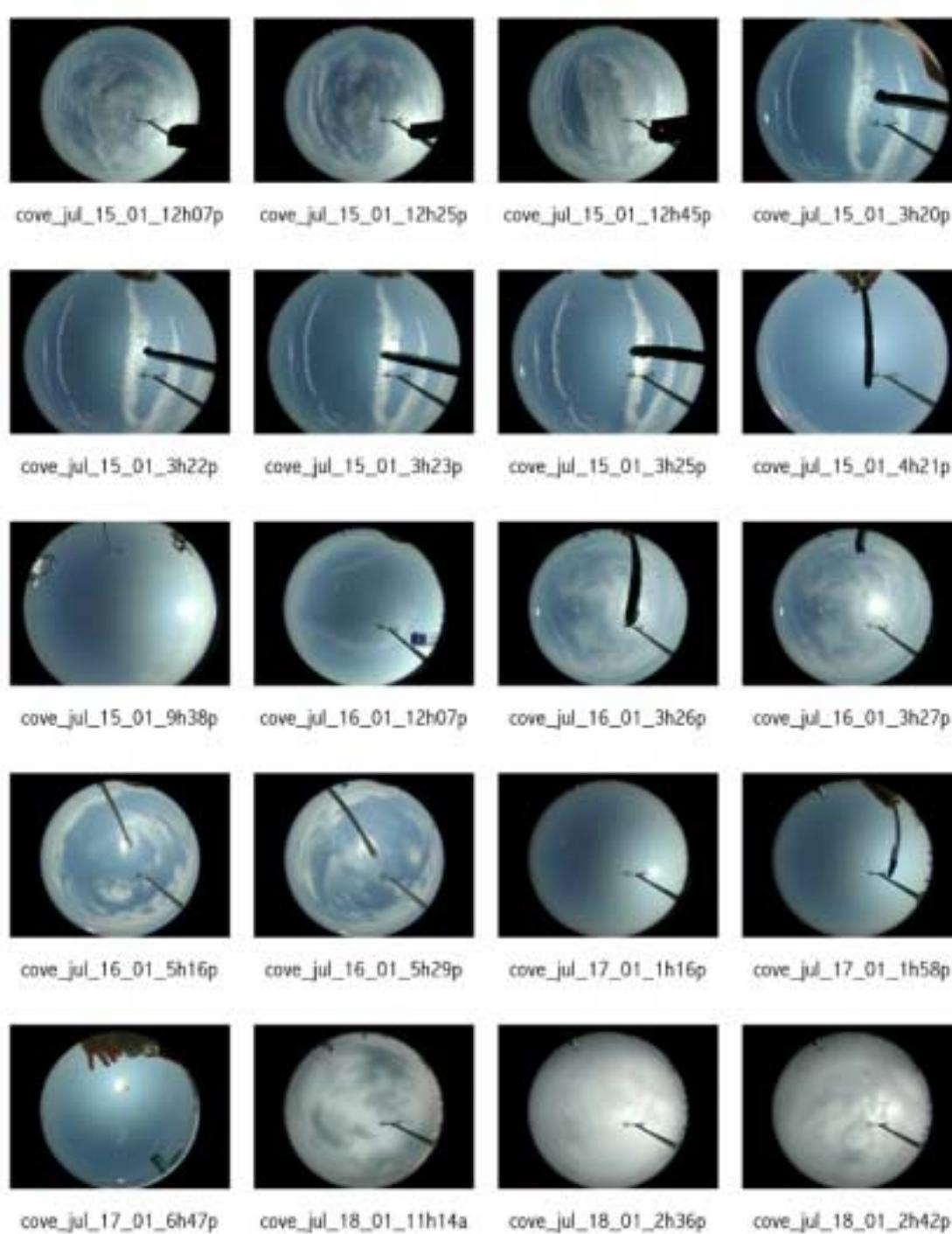
# Objectives from the (GSFC) MODIS Atmosphere Team:

1. **Validation of aerosol retrievals over the ocean**
2. Validation of the aerosol cloud mask over the ocean
3. **Development of aerosol optical thickness and absorption retrievals over glint**
4. Validation of water vapor retrievals over glint (COVE site??)
5. **Combination between LIDAR and MODIS retrievals for separation of size distribution modes/layers**
6. Combination between in situ ground based and remote sensing measurements separating the contribution of each aerosol type for the optical depth.
7. Intercompare spectral fluxes retrieved from MODIS with ground based and possibly OV-10 measurements
8. Intercompare MODIS retrievals with MISR retrievals
9. CAR BRDF over the ocean and other scenes of interest - (as a function of sun angle, aerosol loading, wind and sea state, particularly in the UV and SWIR)
10. CAR sky radiance and surface reflectance in a vertical profile interspersed with short horizontal legs over BRDF site(s).

# *Ground Based Measurements*

## **MODIS aerosol group:**

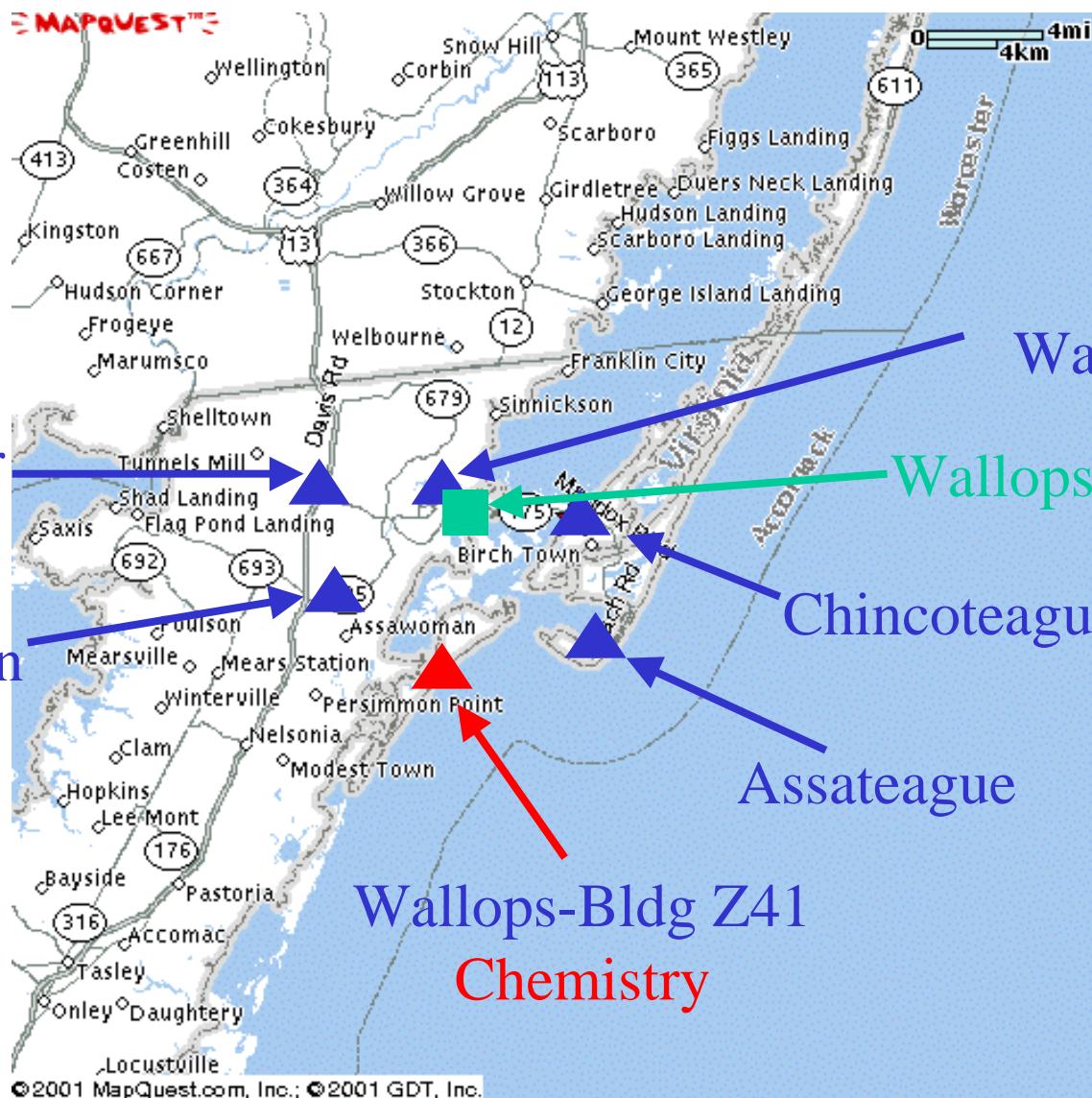
- Full Sky cameras for clouds observations
- Hand held sunphotometers (0.4 to 2.1 um)
- ASD spectral sky and ocean surface radiance measurements
- Spectral Light Absorption measurements
- Aerosol chemical composition and mass concentration
- Electron Microscopy



# Full sky images from the ground

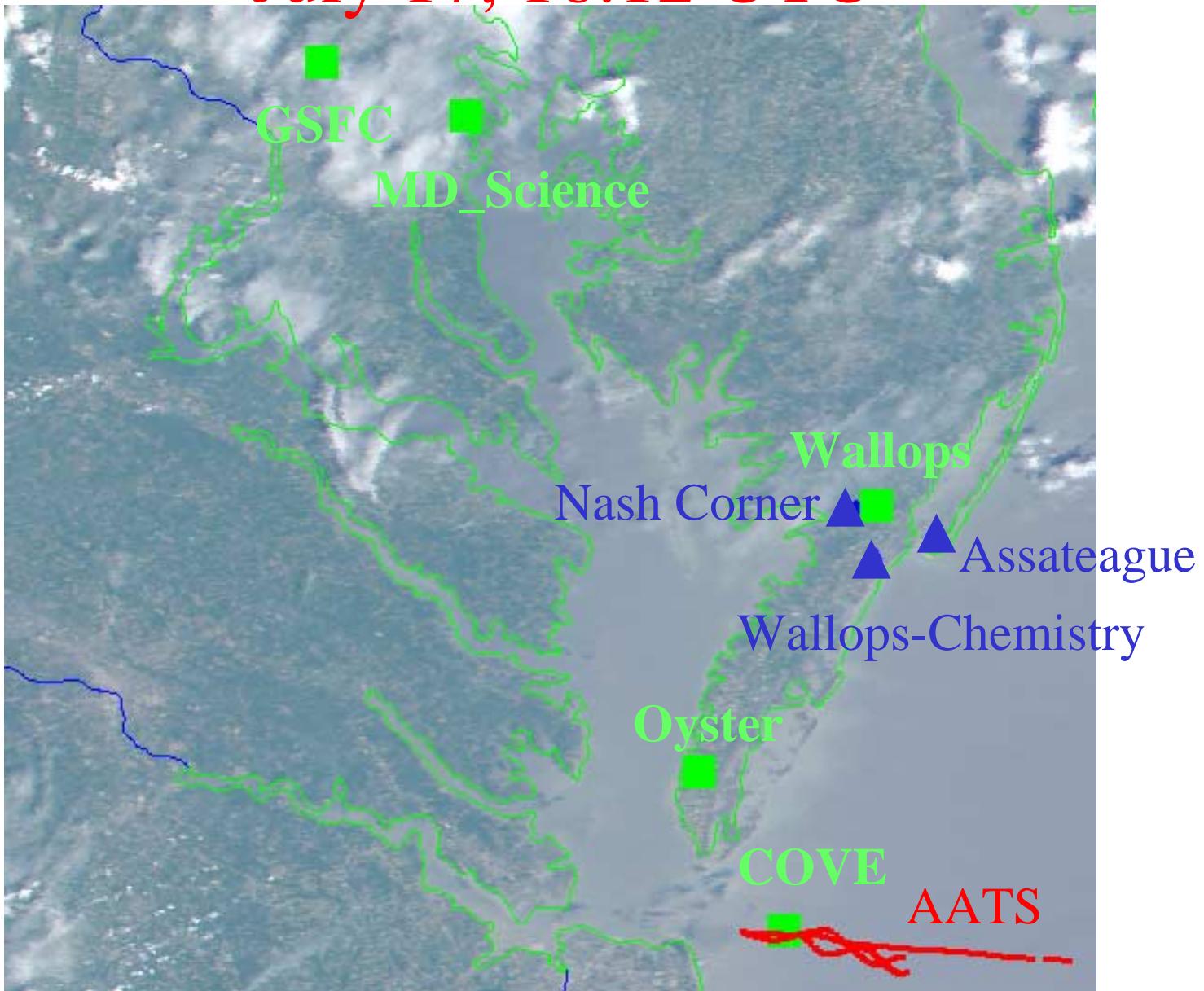
Located at COVE,  
Wallops, and  
Chincoteague.

# MODIS Validation: Spatial Variability Wallops Area MICROTOPS



# MODIS Validation data at overpass

## July 17, 16:12 UTC



# MICROTOPS Locations during Terra

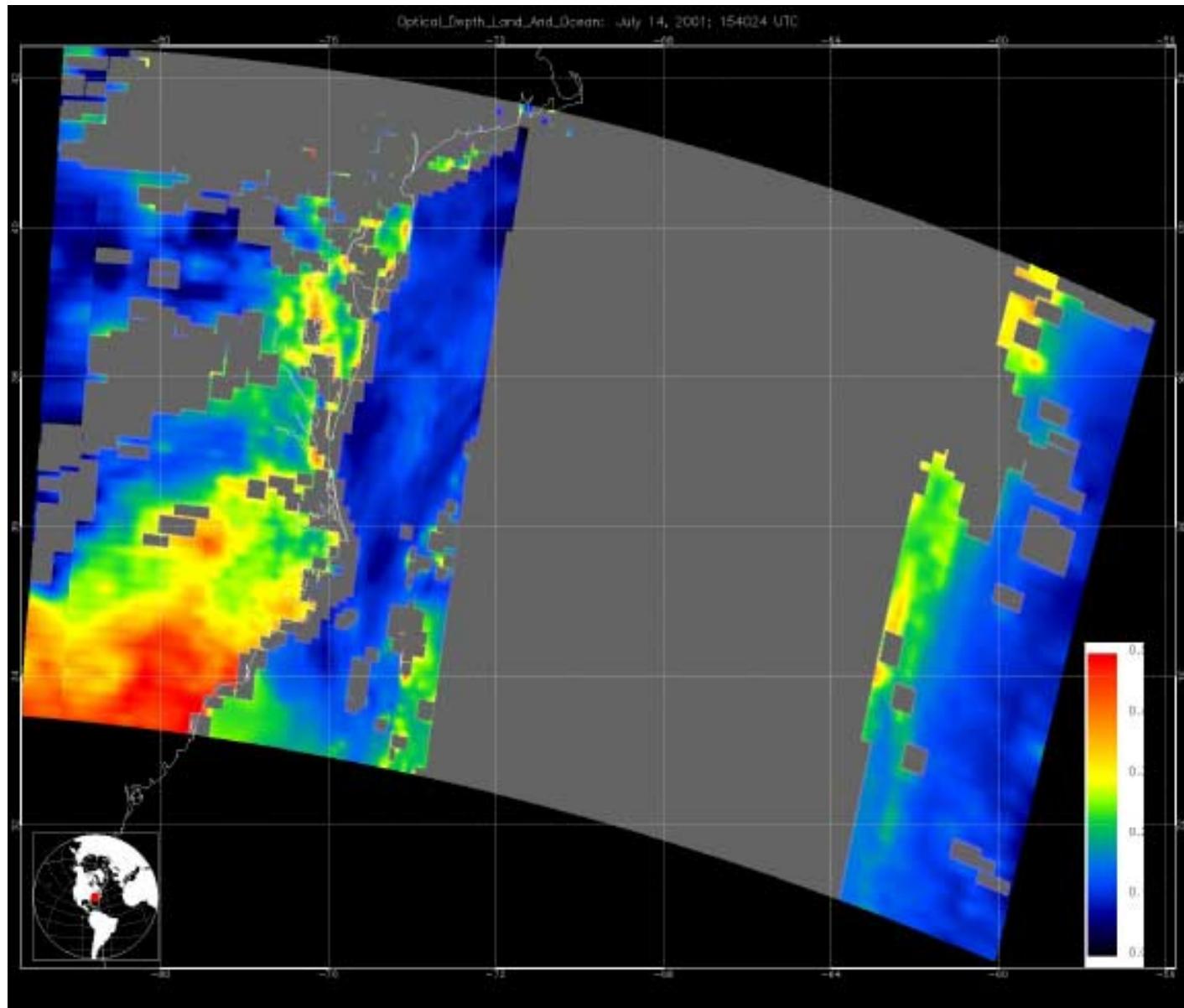
## Microtops locations during Terra overpass

Date/#	1 (Standrd)	2 (Standrd)	10 (1.6 μm)	11 (1.6 μm)	12 (2.1 μm)	13 (2.1 μm)
10-Jul	Chincoteague	Wallops: D1	Assateague	Nash Corner	Assateague	Nash Corner
12-Jul	Assawoman	Nash Corner	Assateague		Assateague	
13-Jul	Nash Corner					
14-Jul	Wallops: D1	Wallops: D1	Wallops: D1	COVE	Wallops: D1	COVE
15-Jul	Nash Corner			COVE		COVE
16-Jul	Nash Corner	Assawoman	Assateague	COVE	Assateague	COVE
17-Jul	Nash Corner	Assawoman	Assateague	COVE	Assateague	COVE
19-Jul				COVE		COVE
20-Jul				COVE		COVE
21-Jul	Wallops: D1	Chincoteague	Wallops: D1	COVE	Wallops: D1	COVE
22-Jul	Wallops: D1			COVE		COVE
23-Jul		Chincoteague	Nash Corner	COVE	Nash Corner	COVE
24-Jul	Wallops: D1	Chincoteague	Wallops: Z41	COVE	Wallops: Z41	COVE
25-Jul	Wallops: Z41	Assateague	Wallops: Z41	COVE	Assateague	COVE
26-Jul				COVE		COVE
27-Jul	Wallops: D1	Assateague		COVE		COVE
28-Jul		Assateague		COVE	Assateague	COVE
30-Jul	Nash Corner	Assateague	Nash Corner		Assateague	
31-Jul	Wallops: Z41	Assateague	Wallops: Z41	Nash Corner	Assateague	Nash Corner
1-Aug	Wallops: Z41	Assateague	Wallops: Z41	Nash Corner	Assateague	Nash Corner
2-Aug	Wallops: Z41	Assateague	Wallops: Z41		Assateague	

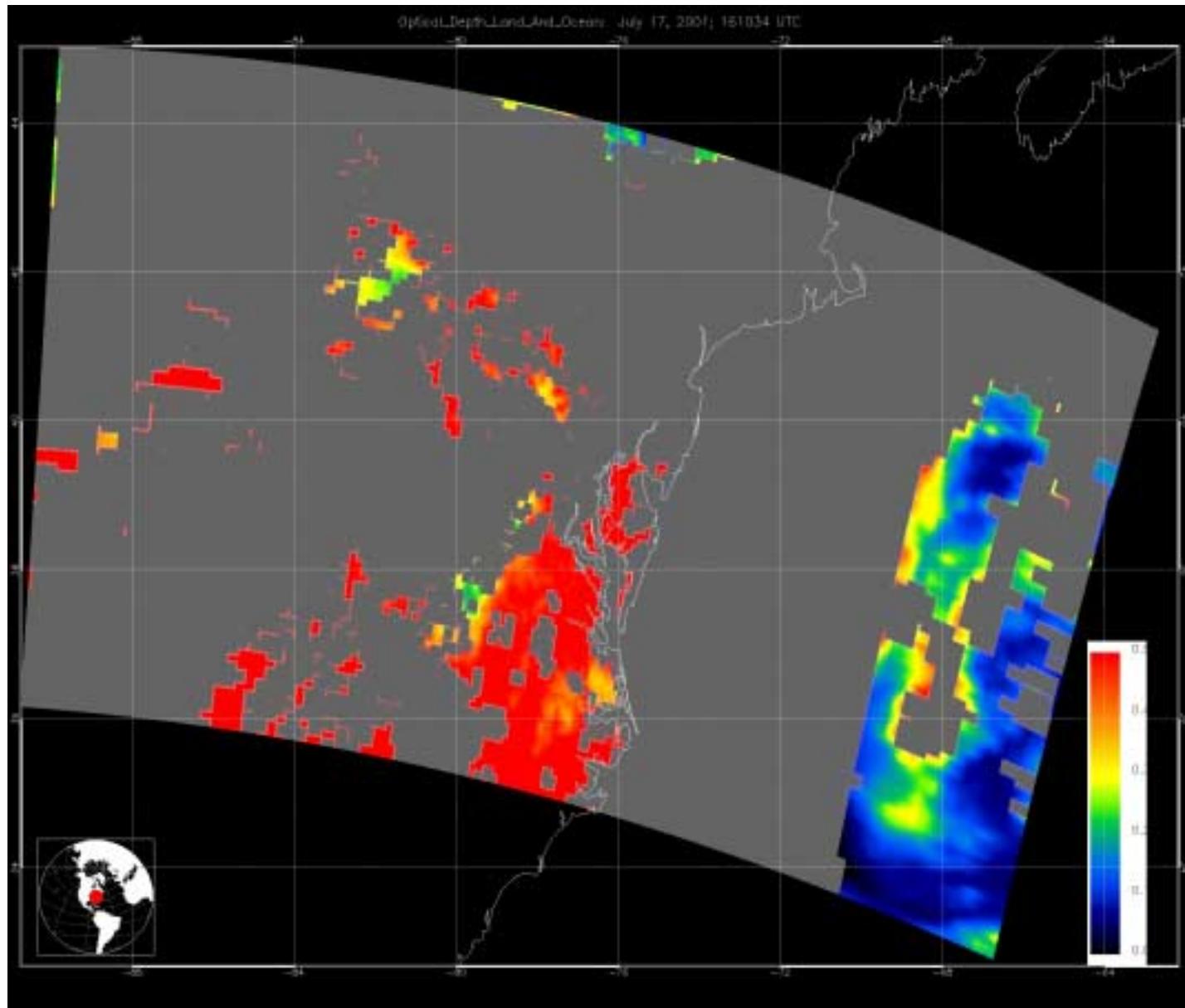
Wallops D-1	37.94, -75.47
Wallops Z-41	37.83, -75.49
Nash Corner	37.95, -75.54
Assawoman	37.87, -75.54

Chincoteague	37.92, -75.38
Assateague	37.88, -75.35
COVE	36.90, -75.70

## July 14<sup>th</sup> – Good Coverage by MODIS over CLAMS



# July 17<sup>th</sup> – CLAMS Area Covered by MODIS Glint



# Potential MODIS Validation

COVE	Longitude	Latitude
	-75.71	36.9

Non-Glint

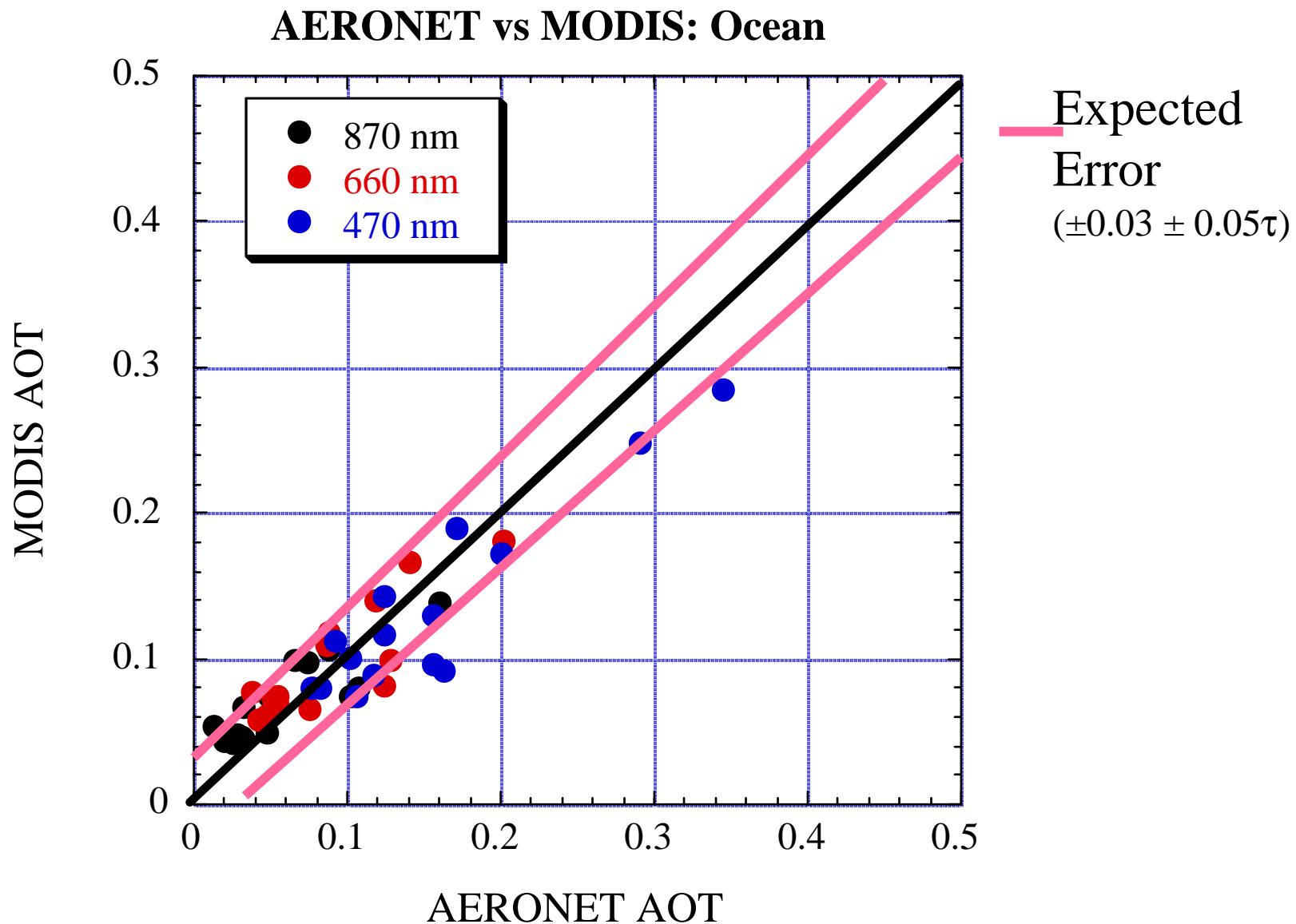
Glint

Almucantars within  
two hours of overpass

MODIS

Date	DOY	Time	SolarZen	Scatter	Glint	COVE	Number Almucanturs	Wallopss	Oyster	1.6/2.1 Mtops	Airplane	ER-2
7/10/01	191	16:05	19.88	158.17	18.06		1					
7/11/01	192	16:45	15.3	111.23	52.14							
7/12/01	193	15:50	21.98	169.54	41.68						X	X
7/13/01	194	16:35	16.6	119.04	39.53							
7/14/01	195	15:40	24.25	159.51	62.29		1			COVE / Hangar	X	
7/15/01	196	16:20	18.19	130.73	23.98					COVE		X
7/16/01	197	15:25	26.52	150.1	77.41					COVE / Assateague		
7/17/01	198	16:10	20	147.62	12.21	1	2	1		COVE / Assateague	X	X
7/18/01	199	15:15	29.08	143.29	89.77					COVE		
7/18/01	200	16:55	16.27	108.13	56.09							
7/19/01	200	16:00	22.03	165.09	30.32	1				COVE		
7/20/01	201	16:40	17.4	114.32	45.19					COVE / Hangar		
7/21/01	202	15:45	24.25	164.85	53.58					COVE		X
7/22/01	203	16:30	18.65	122.87	32.75					COVE / Nash		
7/23/01	204	15:35	26.49	154.58	70.92					COVE / Chem	X	
7/24/01	205	16:15	20.45	137.48	16.52					COVE / Chem		
7/25/01	206	15:20	28.9	146.54	84.65	3				COVE		
7/26/01	207	16:05	22.29	155.07	19.87					COVE		X
7/27/01	208	16:45	18.33	109.63	51.36					COVE		
7/28/01	209	15:50	24.42	166.87	42.67					COVE		
7/29/01	210	16:35	19.68	117.33	39.15							
7/30/01	211	15:40	26.75	158.94	63.92							
7/31/01	212	16:20	21.21	128.84	24.51		1	1	1	Nash Corner	X	X
8/1/01	213	15:25	28.98	150.14	78.83	1	1	1	1	Nash Corner		X
8/2/01	214	16:10	22.97	144.5	15.51	1	2	1	1		X	X

# MODIS vs AERONET: Ocean

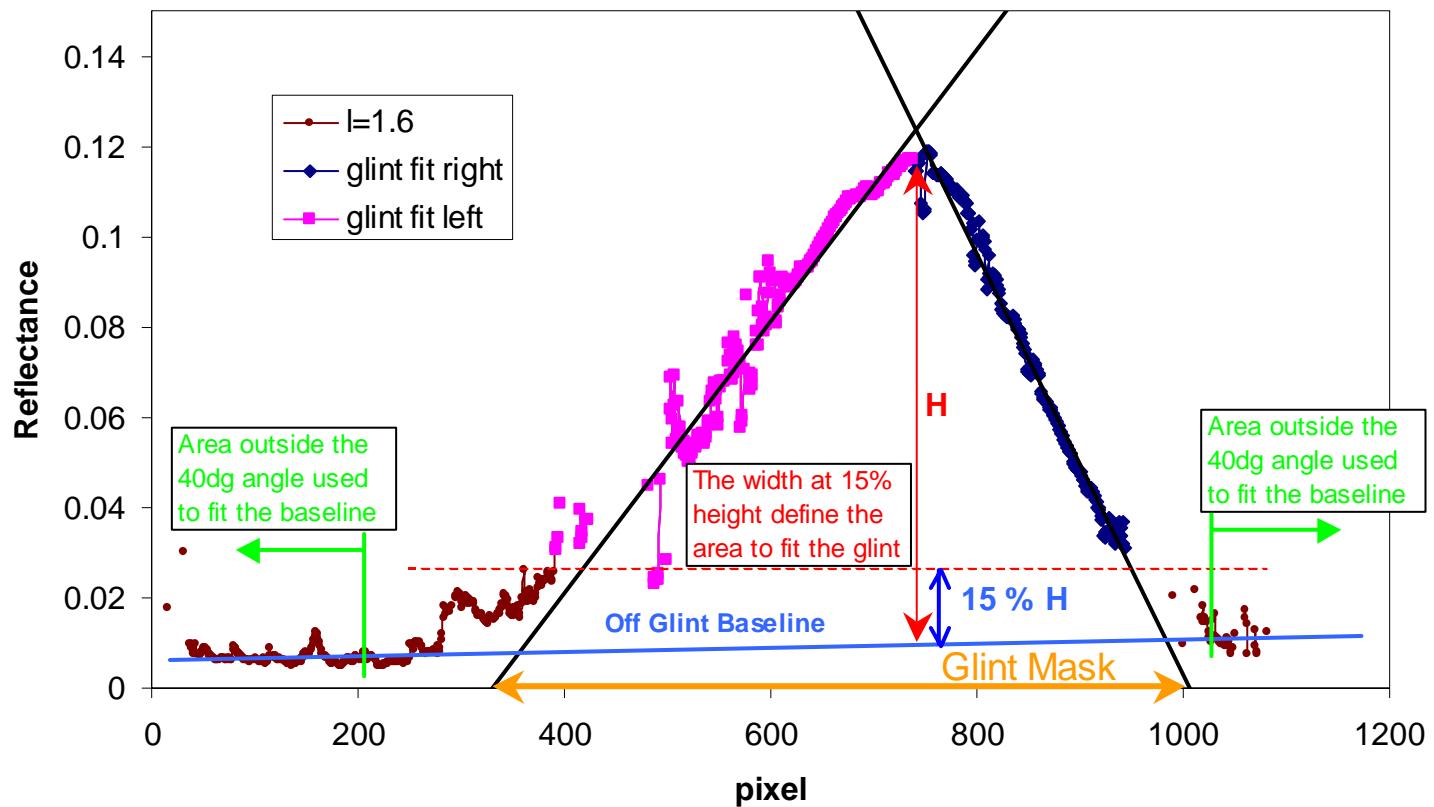


# **In addition to MODIS validation, CLAMS data is a test bed for:**

- Remote sensing of Light Absorption: Cobra Concept
- Glint Mask Development
- Aerosol retrievals over Sun Glint
- Cloud Mask Validation and Developments

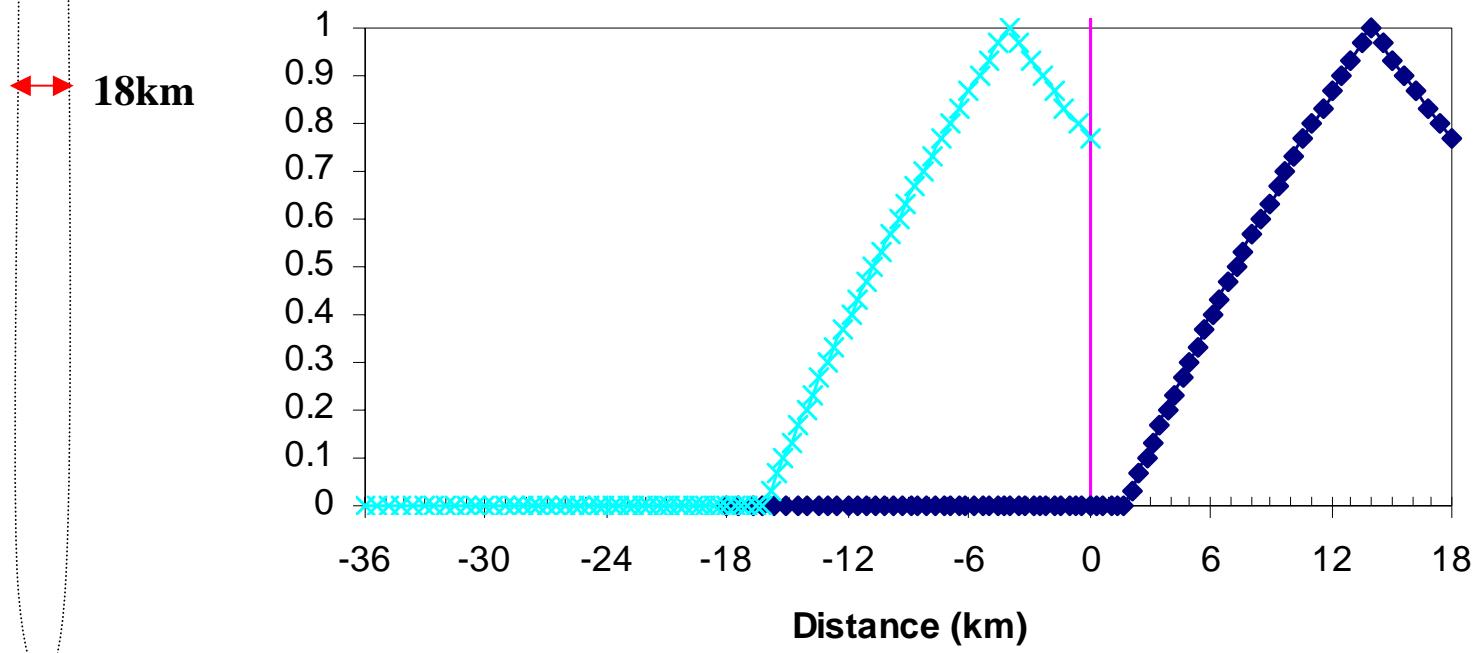
# Dynamic Glint Mask for MODIS

Glint Profiles for Clear region (day 110)



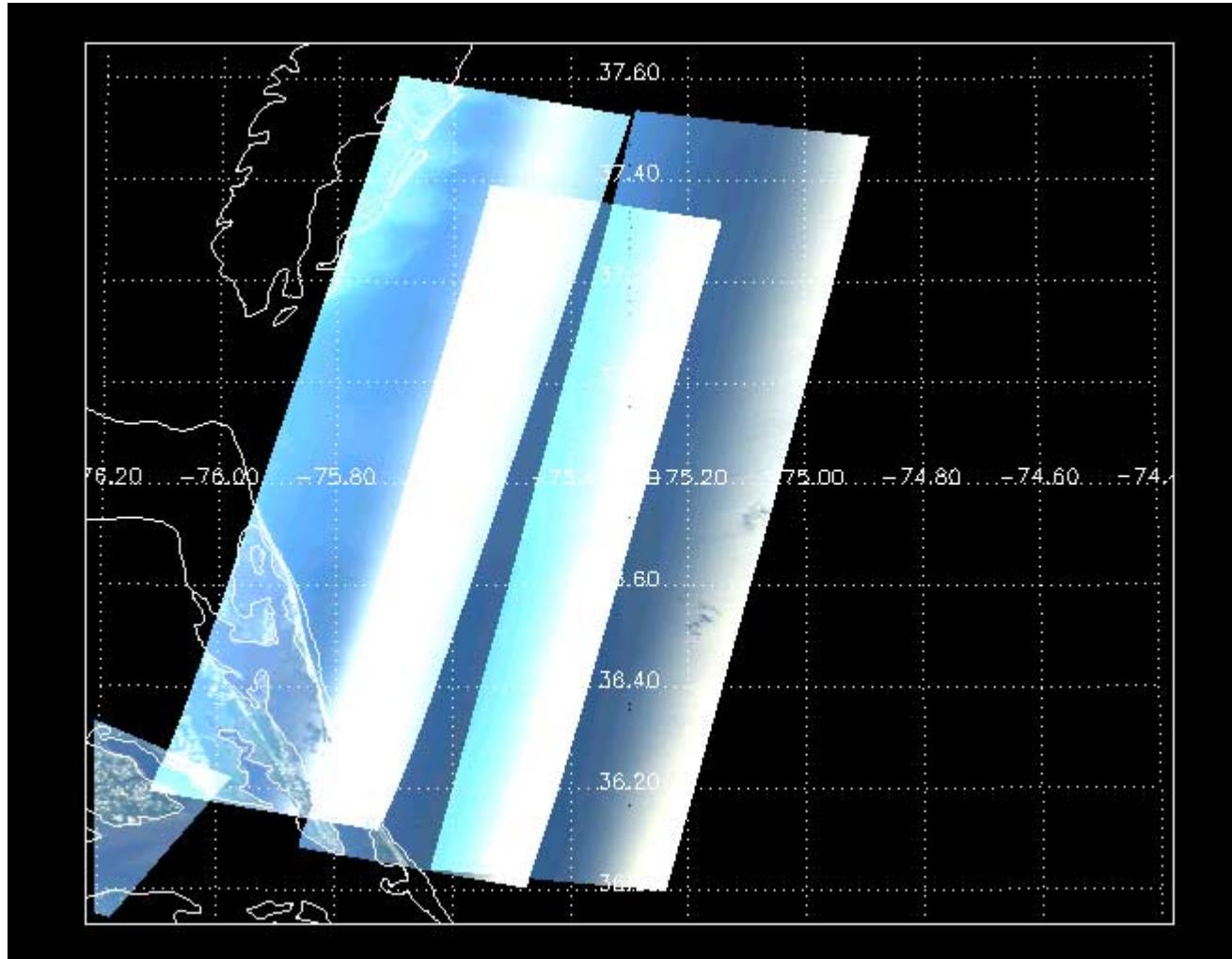
# Overlap of ER-2 race tracks perpendicular to principal plane

**Glint profile simulation with MAS**



# Image Overlap for Sun Glint Studies During CLAMS

This geometry allow for aerosol retrievals in the whole area: glint and non-glint over the same spot

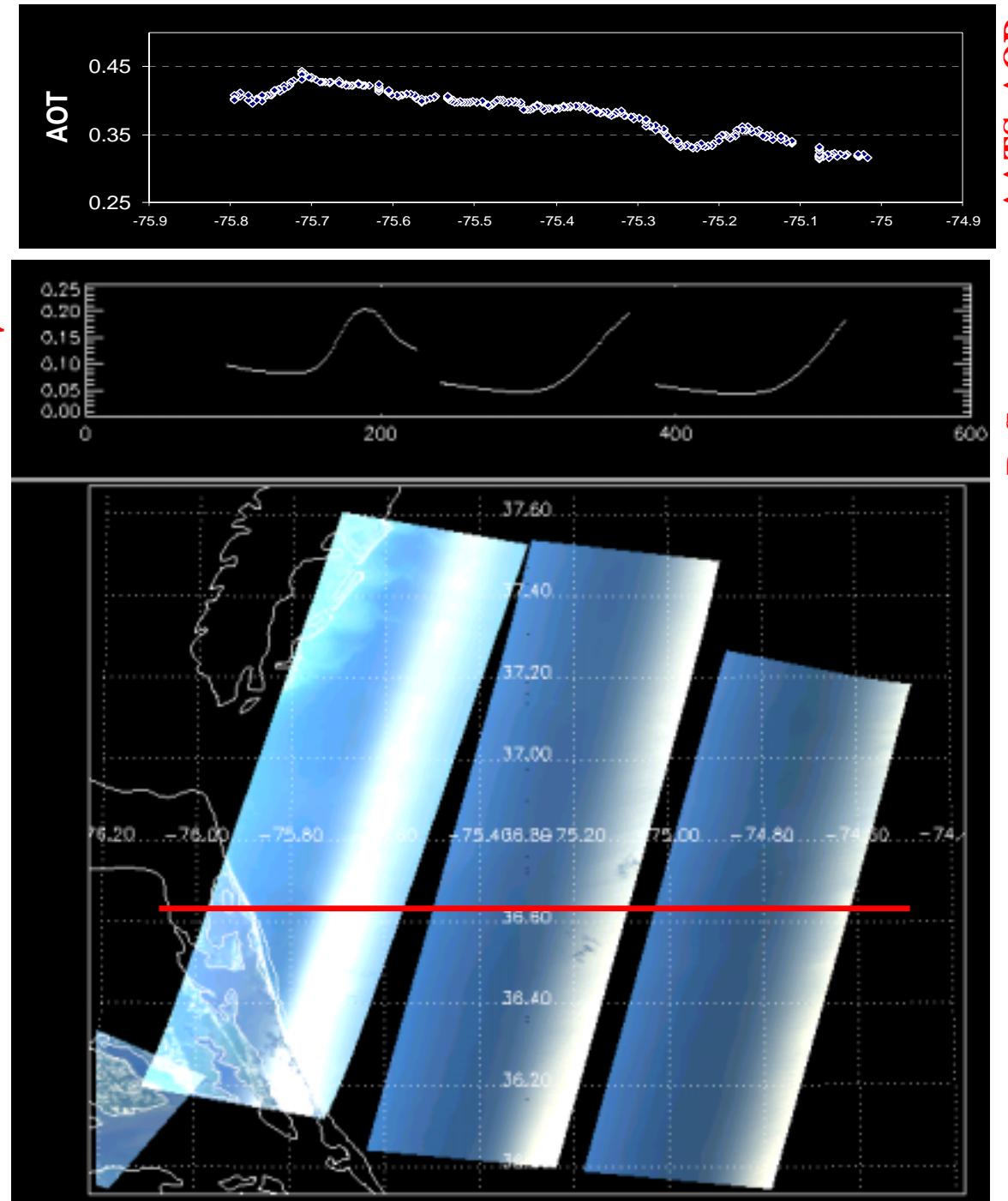


# July 17<sup>th</sup> case:

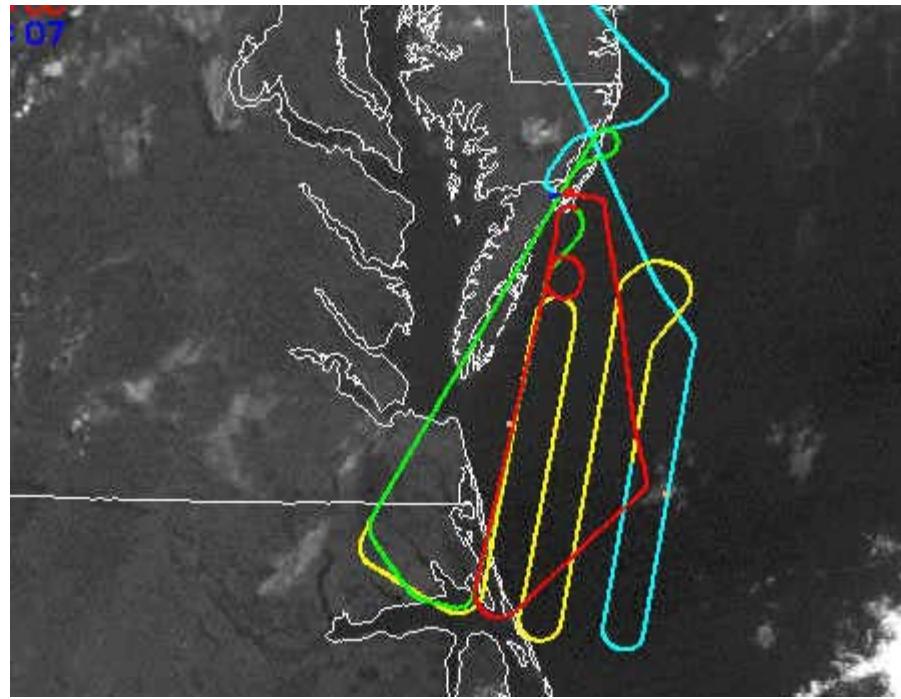
“CLAMS  
geometry allowed  
for glint and non  
glint retrievals  
with MAS over  
the same area”

Each track is  
displaced by  $\frac{1}{2}$   
swatch

(It is showed here only every other  
image for simplicity)

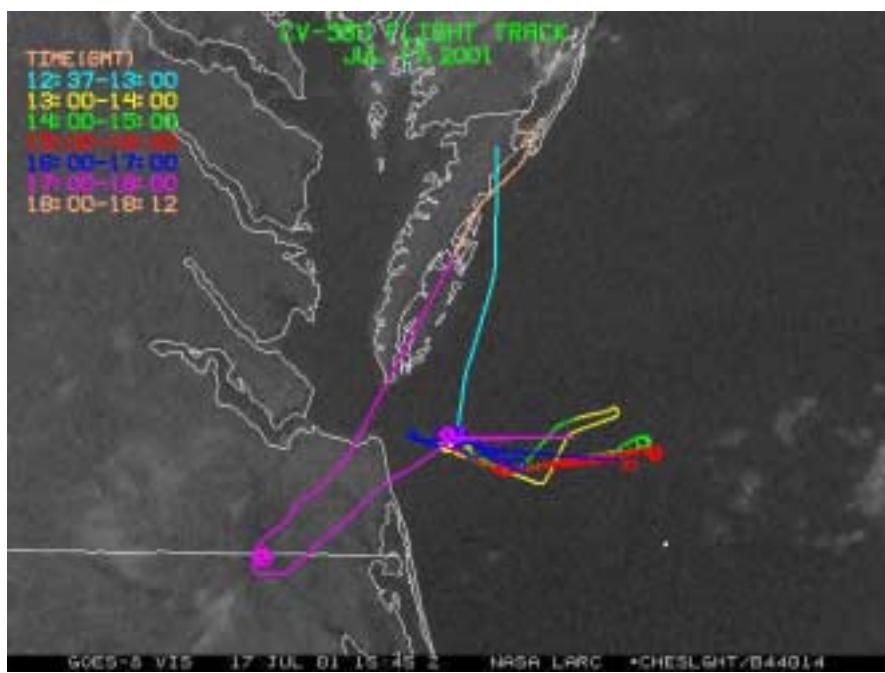


AATS AOD  
Reflectance



Flight Track Comparison  
for July 17<sup>th</sup>

ER 2

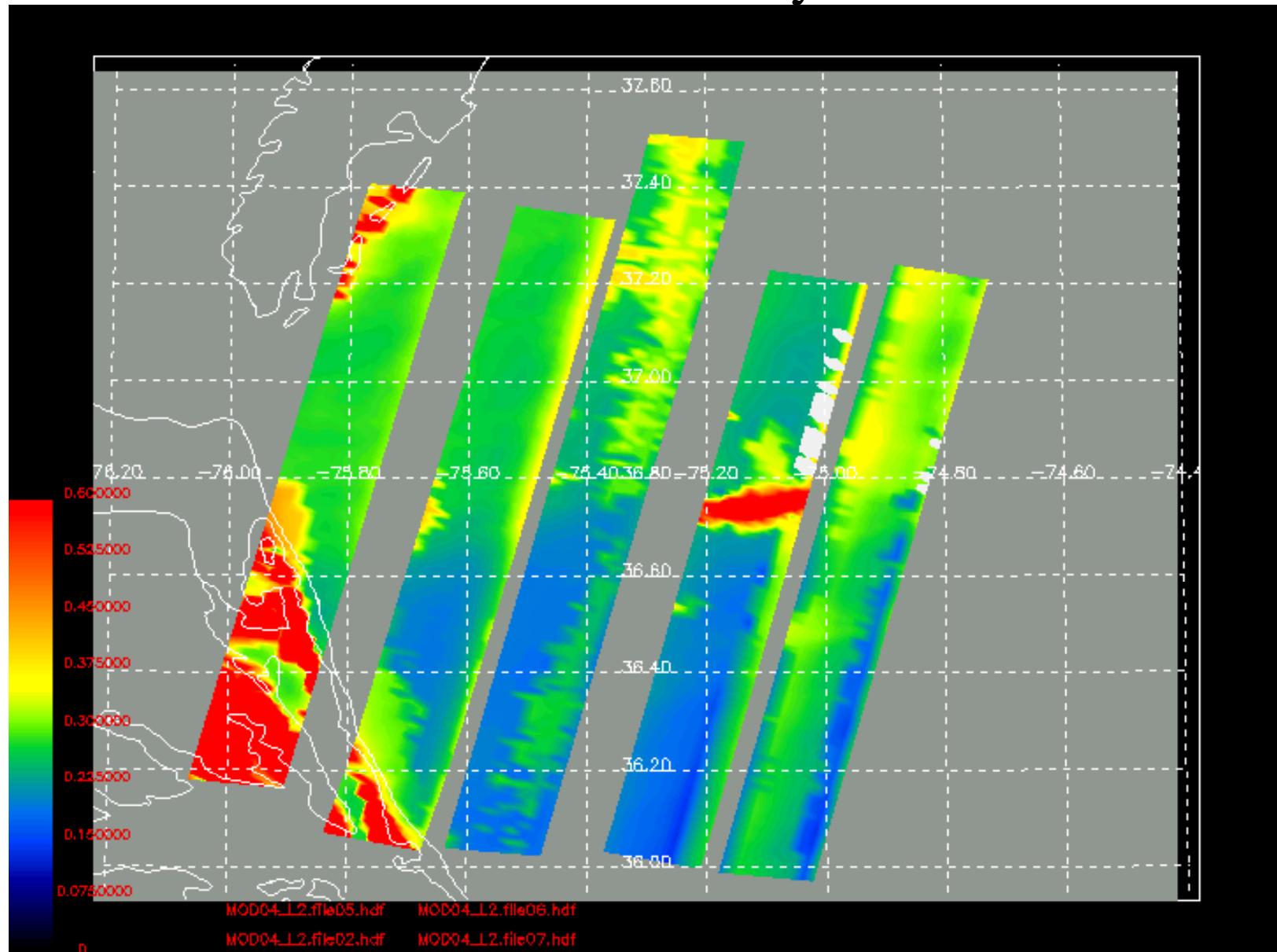


CV 580

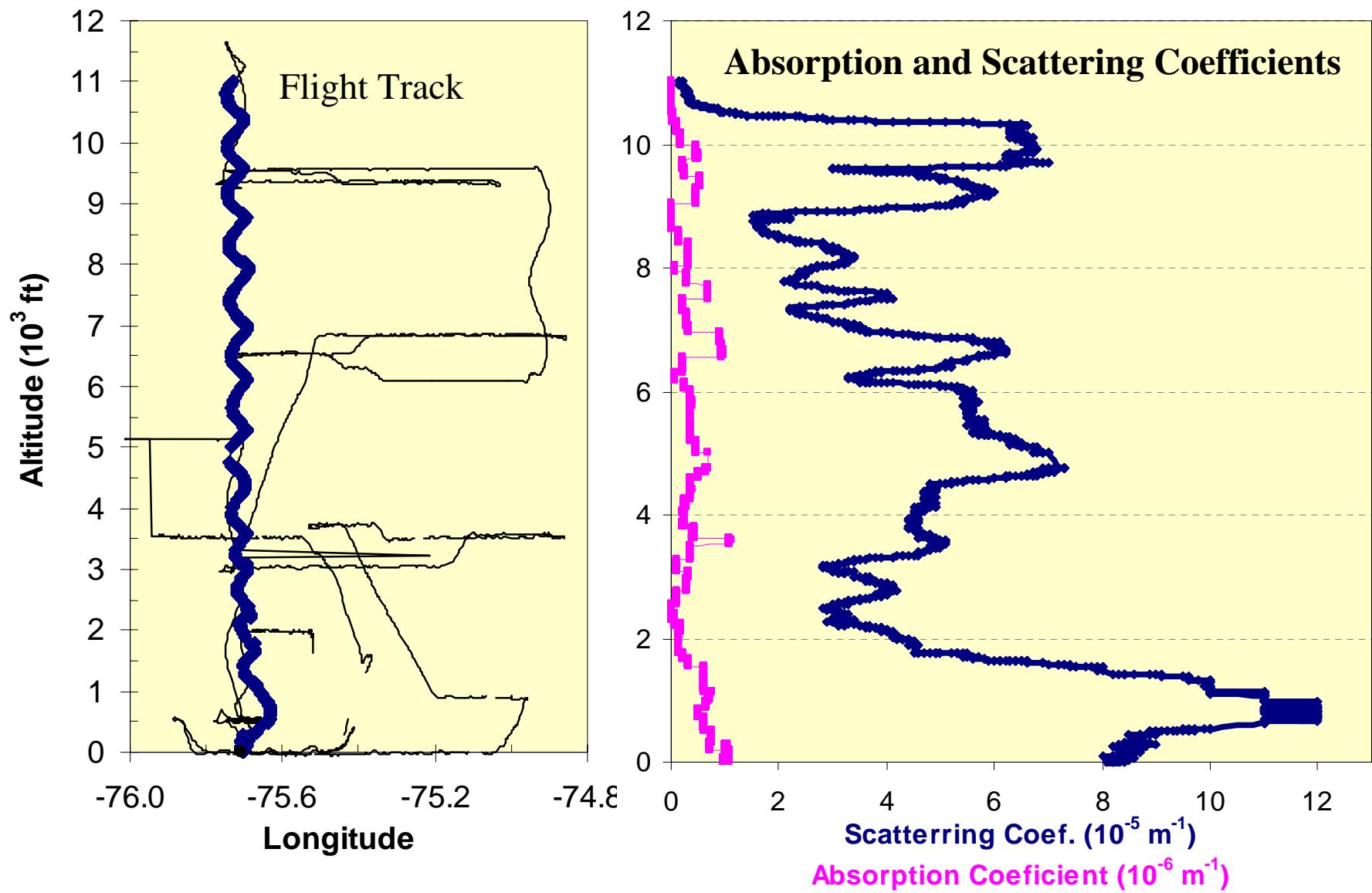
# Need Combination between MAS/MODIS and other sensor for accurate absorption measurements over glint:

- Aeronet over COVE
- In situ CV580 + Cessna GISS
- MAS and Air-MISR 40dg forward
- Need accurate AODs and Aerosol model

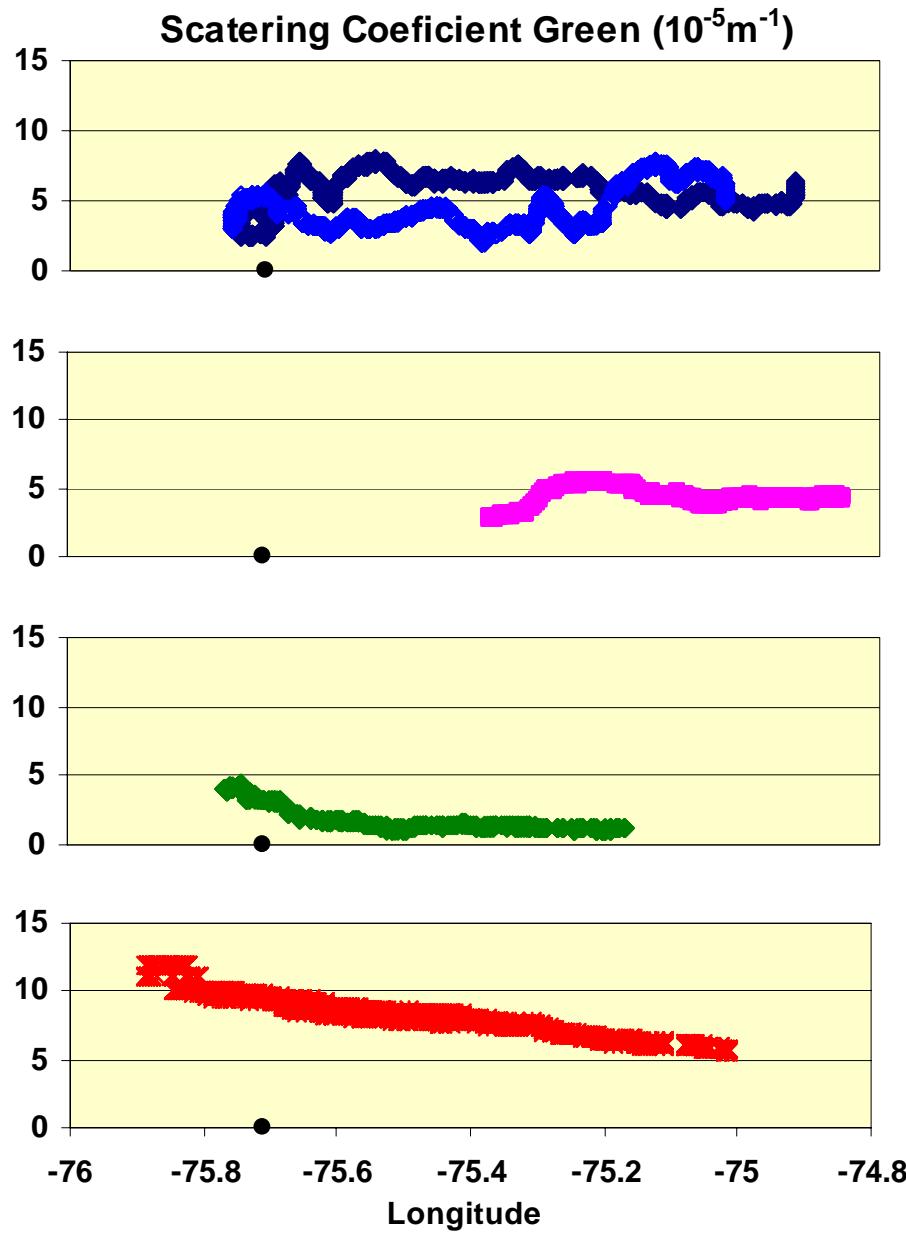
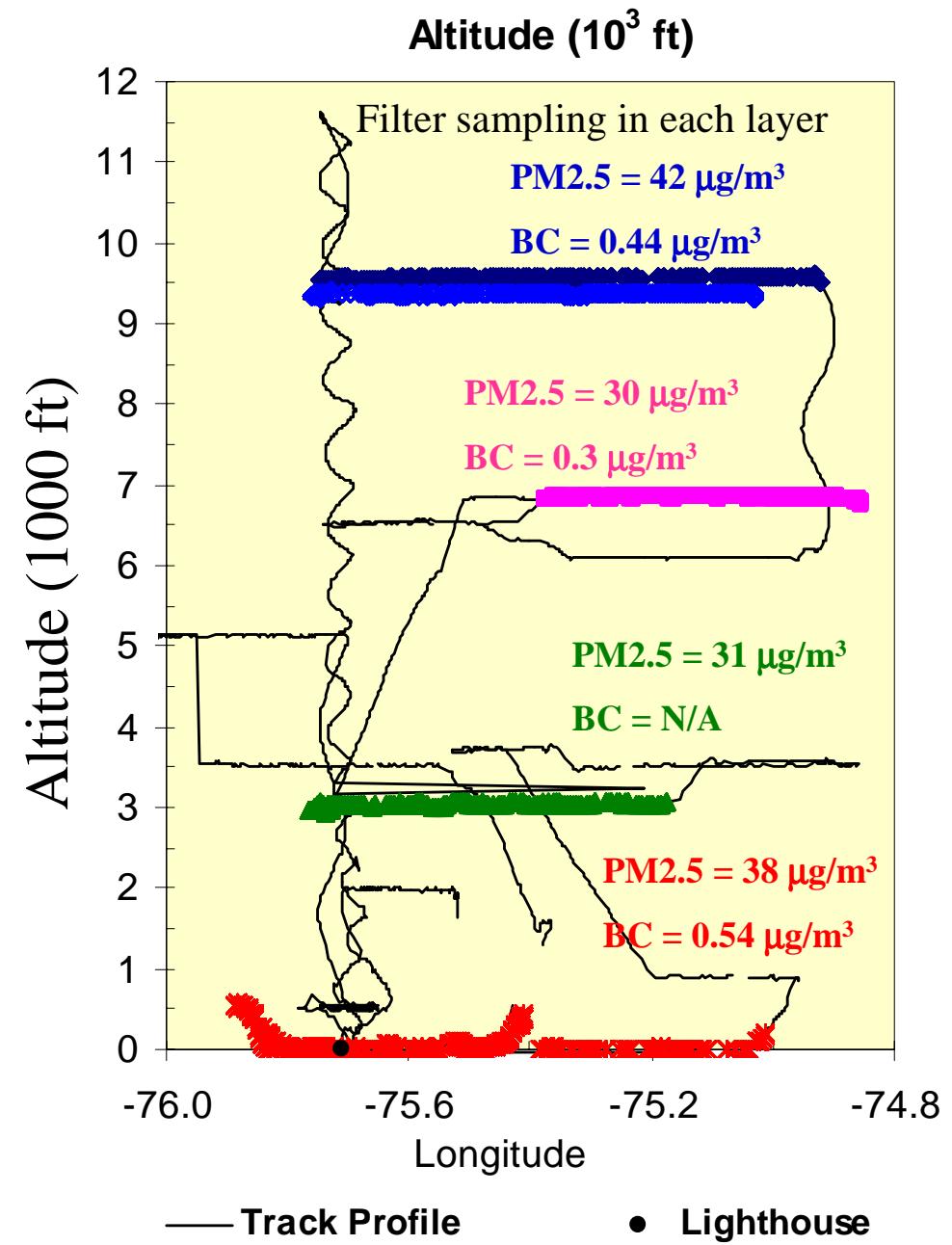
# Preliminar Aerosol Retrievals from MAS during CLAMS - July 17



# Vertical Profile of Scattering and Absorption Coefficients UW CV580

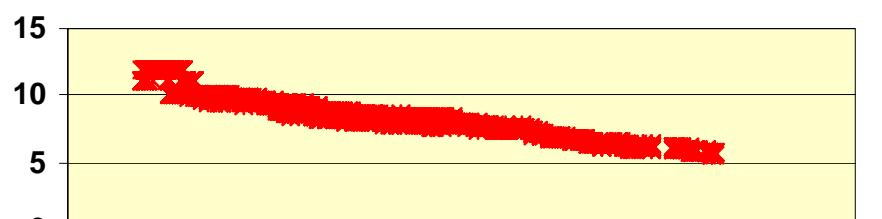
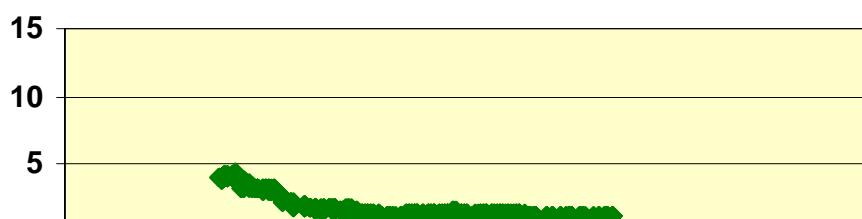
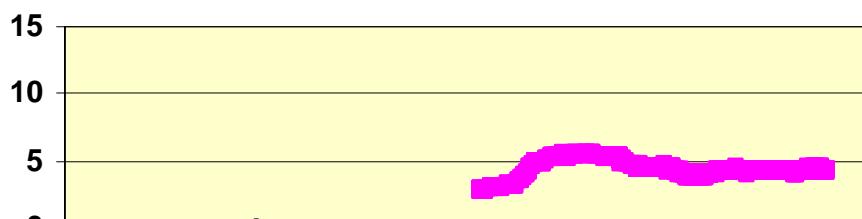
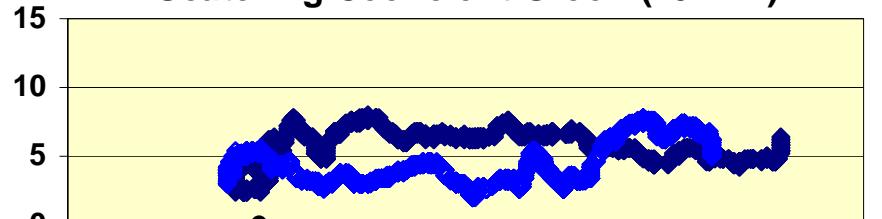


# Vertical Profile by the CV580 – July 17th



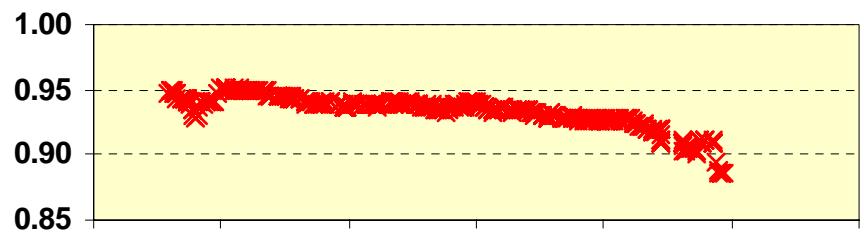
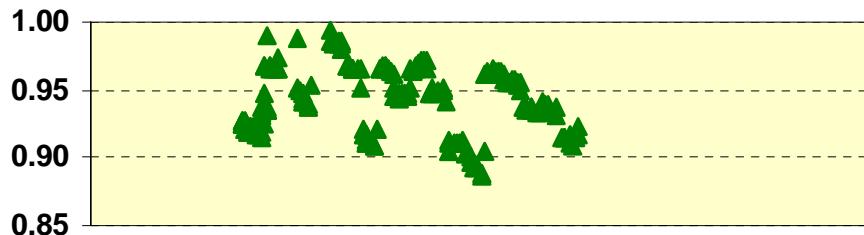
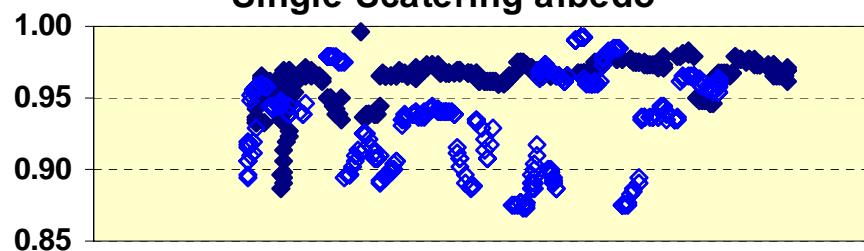
# Physical Properties in Each Layer

Scatering Coeficient Green ( $10^{-5}\text{m}^{-1}$ )



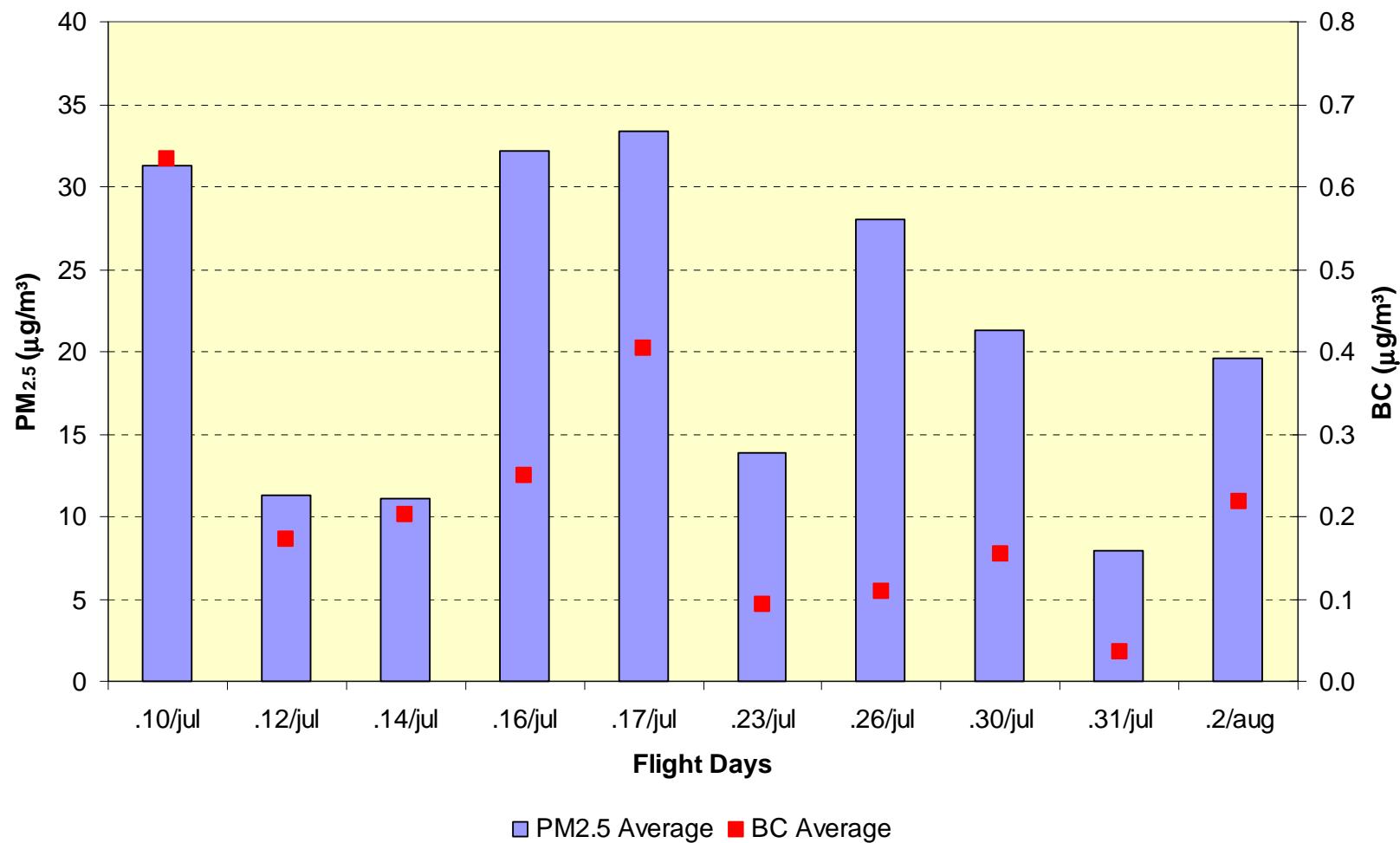
Longitude

Single Scatering albedo



Longitude

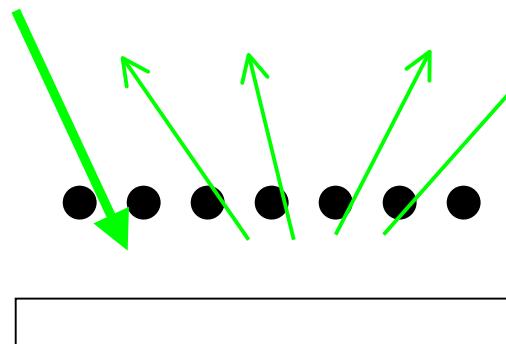
# Flight Average BC and Fine Particle Mass Concentration



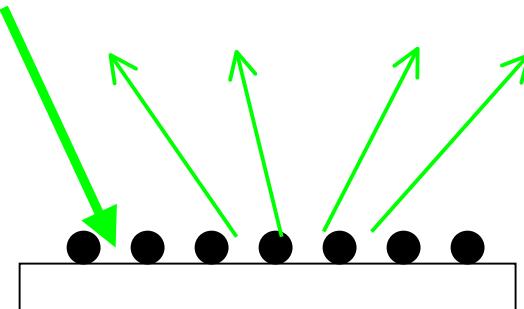
**There is an urgent need to better measure and model Aerosol Absorption, its Spectral Dependence, and its Effects.**

**Simple strategy for Remote Sensing and in Situ:**  
**Particles Reflectance over bright surfaces**

**Particles in suspension in the atmosphere**



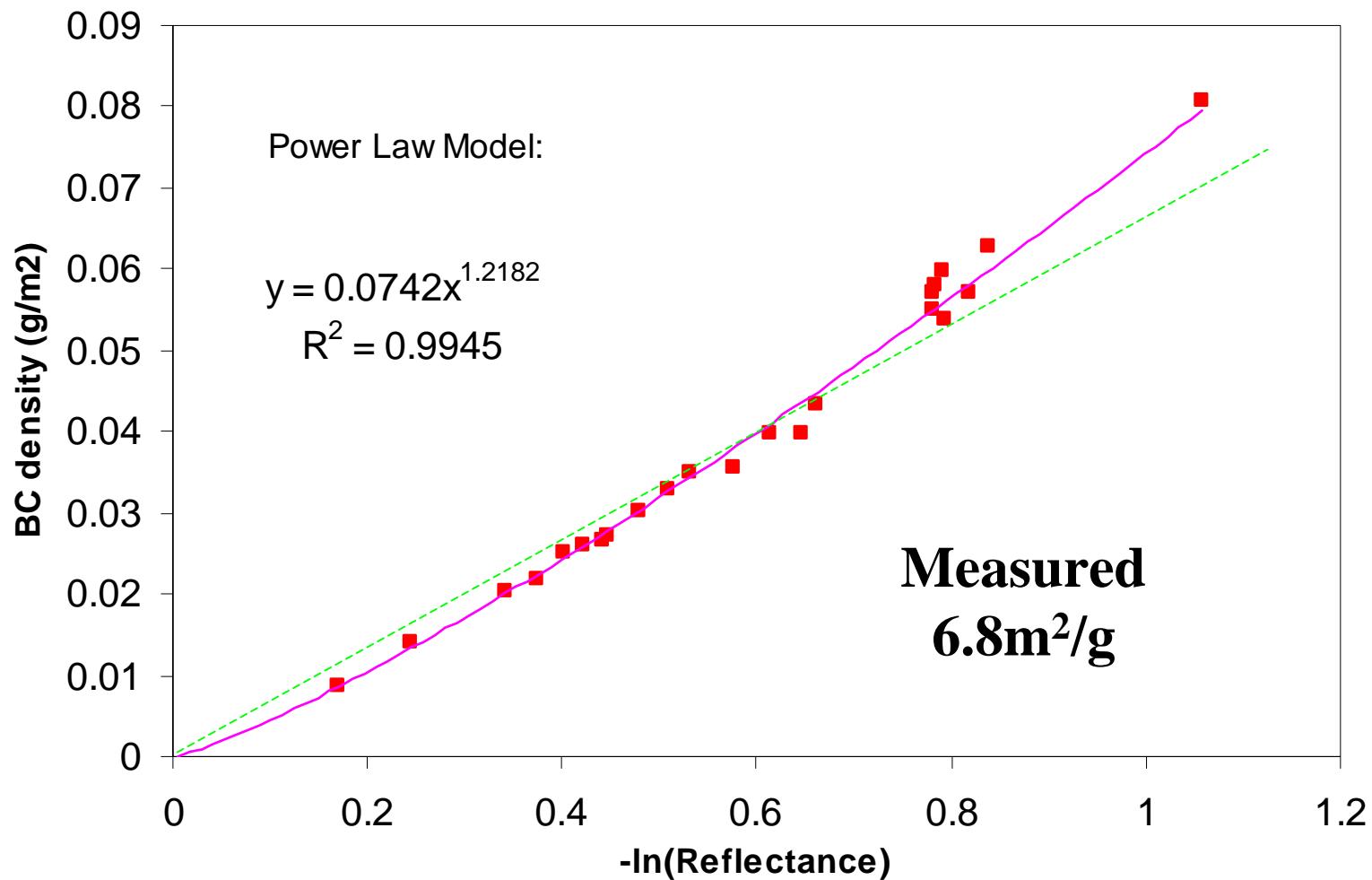
**Particles collected on filter's surface**



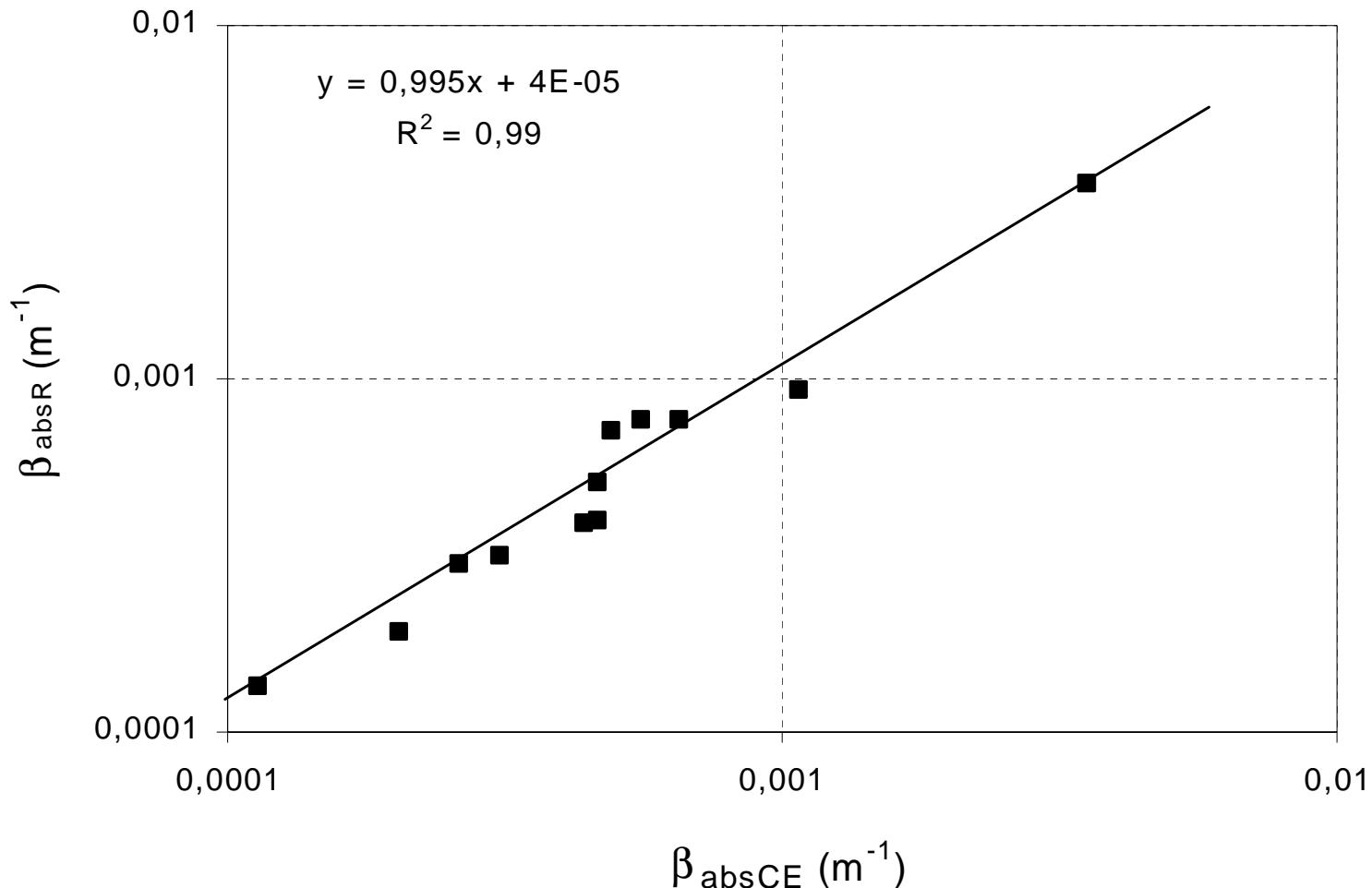
**Has already been used for a long time...**

# Semi-Empirical Calibration:

## Aerosol Reflectance versus Mass Density for BC Standard Particles

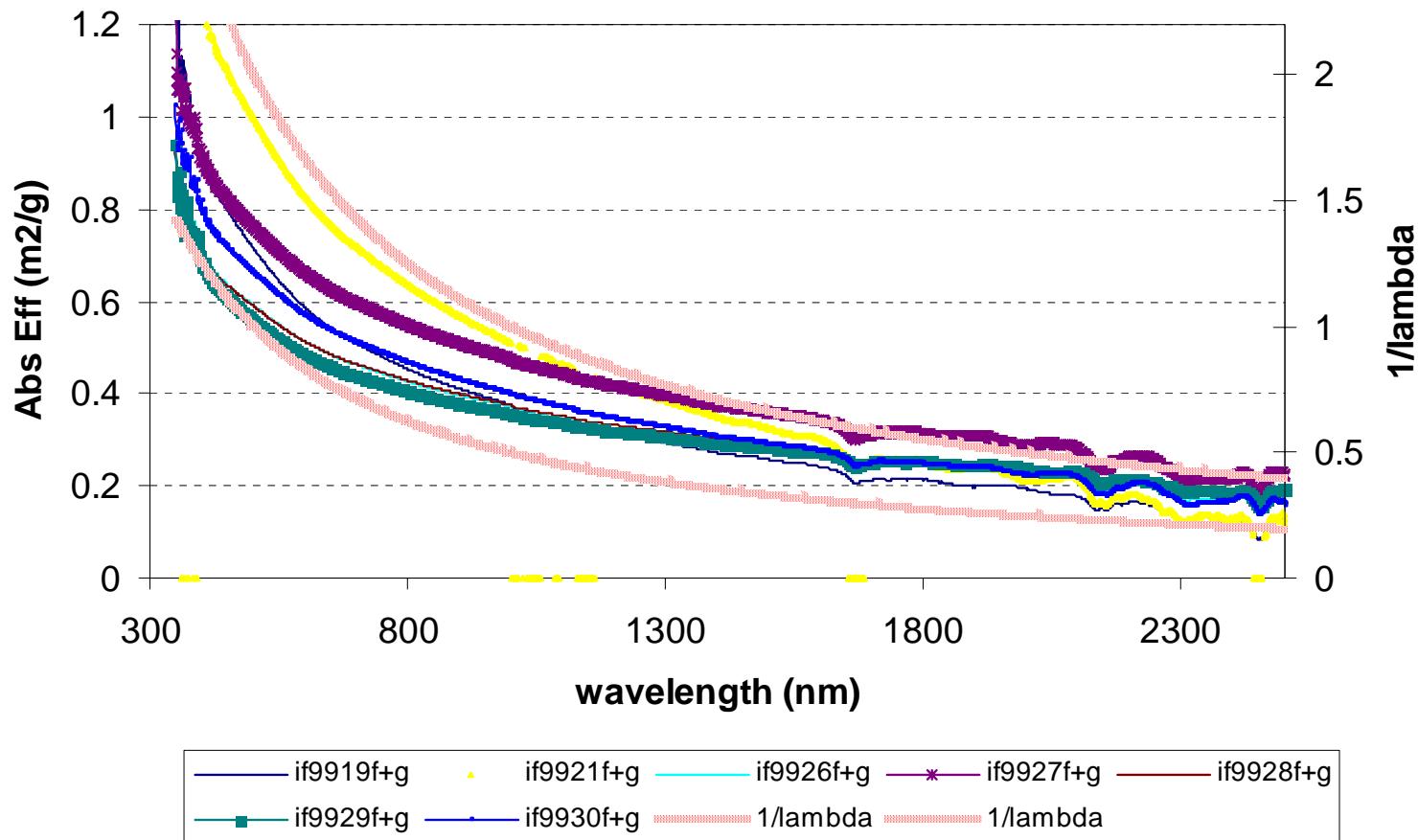


Intercomparison between Absorption Coefficients obtained  
by the **calibrated reflectance technique versus the**  
**extinction cell** results in the University of Washington  
Aircraft for biomass burning particles in Brazil



# Fine + Coarse Particle Mass Absorption Efficiency ( $\text{m}^2/\text{g}$ )

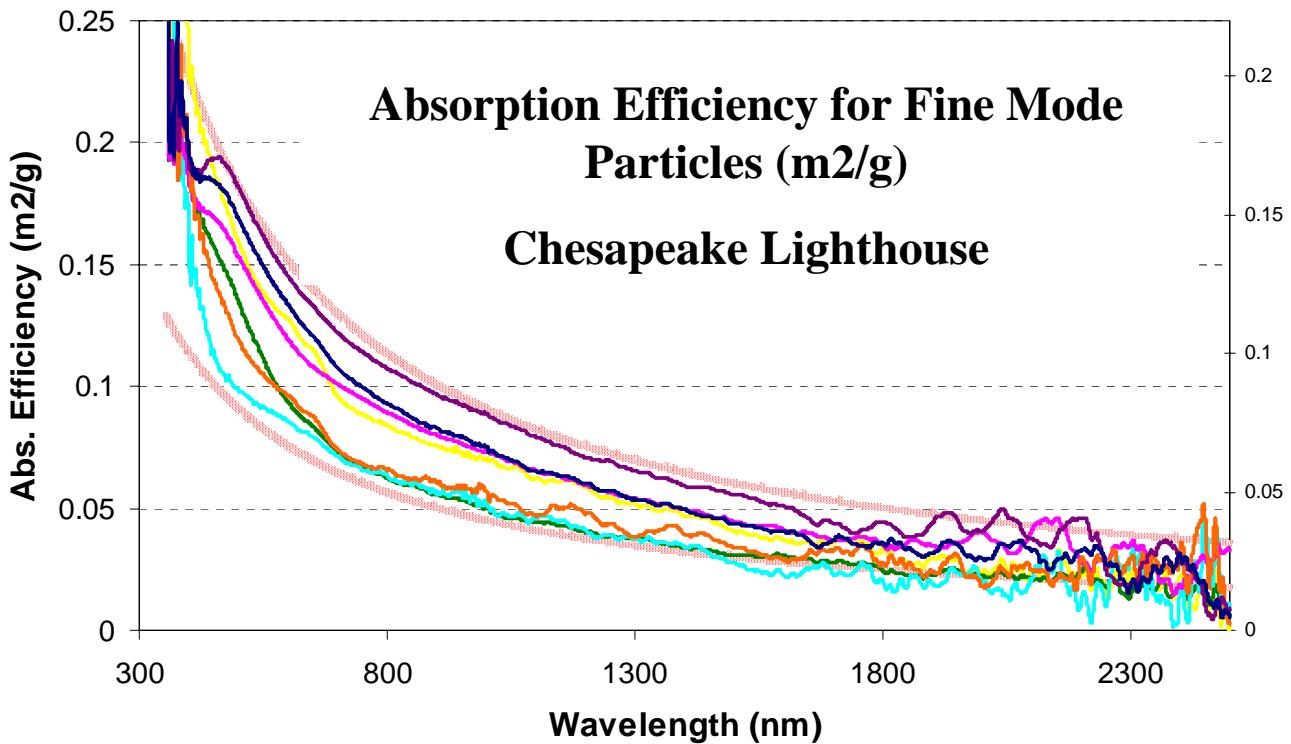
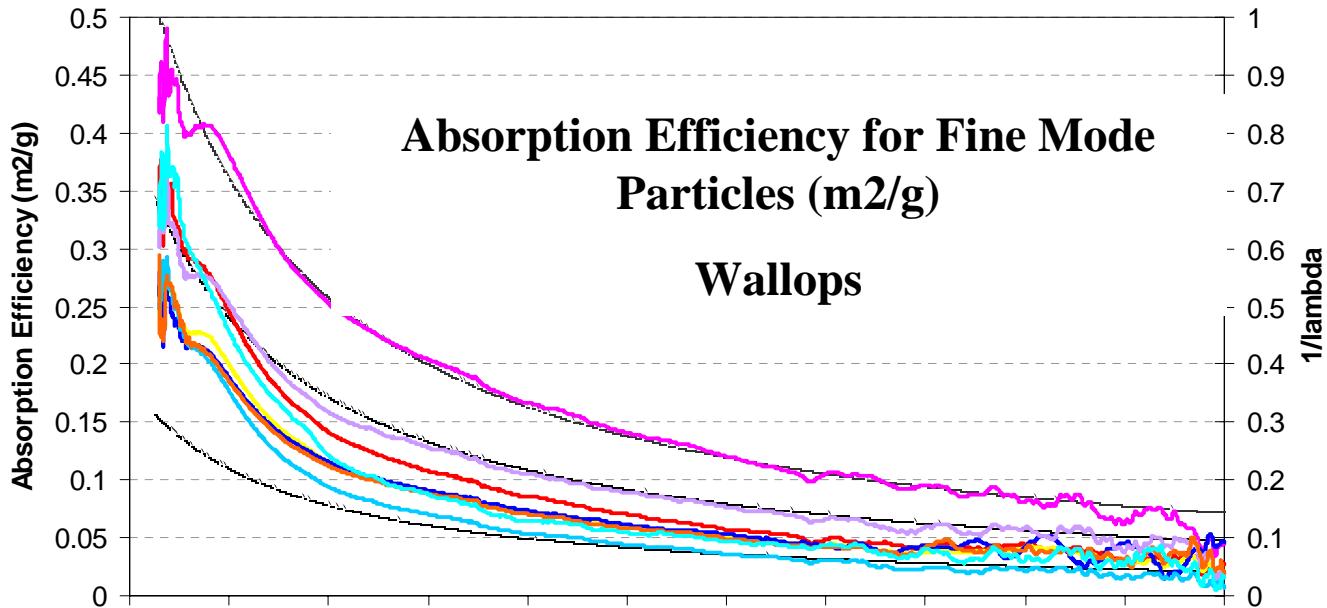
## Sao Paulo – Winter 1999



# CLAMS Experiment:

In situ and Remote Sensing Measurements for “Terra” validations and new developments – remote sensing of Absorption over the ocean glint

**Eastern US: much lower absorption than aerosols from Sao Paulo**



Expecting soon,

- Aerosol elemental composition by PIXE
- Comparisons MAS and MODIS X AATS
- Combination of MAS X NASA Giss polarimeter
- Absorption results over glint
- More comprehensive combination of in situ and remote sensing data